

Antarctic and Sub-Antarctic Asteroidea database

Camille Moreau^{1,2}, Christopher Mah³, Antonio Agüera¹, Nadia Améziane⁴,
David Barnes⁵, Guillaume Crokaert¹, Marc Eléaume^{4,6}, Huw Griffiths⁵,
Charlène Guillaumot¹, Lenaïg G. Hemery⁶, Anna Jazdzewska⁷,
Quentin Jossart^{1,8}, Vladimir Laptikhovsky^{9,10}, Katrin Linse⁵, Kate Neill¹¹,
Chester Sands⁵, Thomas Saucède², Stefano Schiaparelli¹²,
Jacek Siciński⁷, Noémie Vasset^{4,13}, Bruno Danis¹

1 Marine Biology Lab, CP160/15 Université Libre de Bruxelles (ULB) 50, B-1050 Brussels, Belgium **2** UMR CNRS 6282 Biogéosciences, Université de Bourgogne Franche-Comté (UBFC) 6 Boulevard Gabriel, F-21000 Dijon, France **3** Department of Invertebrate Zoology, National Museum of Natural History, Smithsonian Institution, Washington, D.C. **4** Muséum National d'Histoire Naturelle, Station de Biologie Marine, Place de la Croix, BP 225 9182 Concarneau Cedex **5** British Antarctic Survey, High Cross, Madingley Rd, Cambridge CB3 0ET, United Kingdom **6** Muséum National d'Histoire Naturelle, Département Origines, UMR7205 ISYEB MNHN-CNRS-UPMC-EPHE, CP51, 57 rue Cuvier, 75231 Paris Cedex 05, France **7** University of Lodz, Faculty of Biology and Environmental Protection, Department of Invertebrate Zoology and Hydrobiology, Laboratory of Polar Biology and Oceanobiology. 12/16 Banacha st., 90-237 Lodz, Poland **8** Marine Biology, Vrije Universiteit Brussel (VUB), Pleinlaan 2, 1050 Brussels, Belgium **9** Centre for Environment, Fisheries and Aquaculture Science, Pakefield Road, Lowestoft NR33 0HT, United Kingdom **10** Shallow Marine Surveys Group, P.O. Box 598, Stanley FIQQ 1ZZ, Falkland Islands **11** National Institute of Water and Atmospheric Research, Coasts and Oceans Centre, 301 Evans Bay Parade, Wellington, New Zealand **12** Dipartimento di Scienze della Terra, dell'Ambiente e della Vita (DISTAV), Università di Genova, C.so Europa 26, Genova I-16132 Italy **13** Noémie Vasset has been central in compiling all POKER 2 samples, among other things, while she was at the MNHN. She passed away August 22, 2016

Corresponding author: Camille Moreau (mr.moreau.camille@gmail.com)

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Abstract

The present dataset is a compilation of georeferenced occurrences of asteroids (Echinodermata: Asteroidea) in the Southern Ocean. Occurrence data south of 45°S latitude were mined from various sources together with information regarding the taxonomy, the sampling source and sampling sites when available. Records from 1872 to 2016 were thoroughly checked to ensure the quality of a dataset that reaches a total of 13,840 occurrences from 4,580 unique sampling events. Information regarding the reproductive strategy (brooders vs. broadcasters) of 63 species is also made available. This dataset represents the most exhaustive occurrence database on Antarctic and Sub-Antarctic asteroids.

Keywords

Antarctic, Asteroidea, presence-only data, Southern Ocean, Sub-Antarctic

Introduction

Mapping and understanding life diversity are major issues for the community of biologists and ecologists who focus on the Southern Ocean (SO). For several years, many initiatives such as the International Polar Year, the Census of Antarctic Marine Life (CAML 2005–2010), the Scientific Committee on Antarctic Research: Marine Biodiversity Information Network (SCAR MarBIN, www.biodiversity.aq) or the Biogeographic Atlas of the Southern Ocean (De Broyer et al. 2014) have also gathered information from distinct and transversal scientific domains to provide new multidisciplinary insights in the study of the SO marine ecosystems, linking biogeographic, phylogeographic, physiological, oceanographic, and biogeochemistry data. Such programs have established the most exhaustive and accurate inventories of scientific data ever, since the first historical researches of James Cook in 1772–1775 in the region, and have provided open source information systems (e.g., Register of Antarctic Marine Species, De Broyer and Danis 2010; Global Biodiversity Information Facility, <http://www.gbif.org>; Ocean Biogeographic Information System <http://www.iobis.org/>; Van de Putte et al. 2015, <http://www.biodiversity.aq>).

This extensive assessment was pursued by major improvements in methodologies and data analyses. Improvement of dataset completeness and resolution facilitates modelling approaches (Gutt et al. 2012) that provide interesting tools to better understand distribution patterns in this poorly documented part of the world.

Among benthic taxonomic groups, Asteroidea (Echinodermata) are well represented in the SO with 12% of the global species richness present in the region (Mah and Blake 2012). Around 300 species (Moreau et al. 2015) were reported at all depths including some potential keystone species in benthic communities (McClintock et al. 1988, 2008). As for many taxonomic groups, adaptations of invertebrates to the polar conditions of the SO environments have been widely reported (Peck 2002, 2016) and have led to unique biological traits and life-strategies as well as high levels of endemism in the region (Chown et al. 2015). In particular, reproductive strategies are diversified in the SO with a distinction between brooding and broadcasting species (Poulin et al. 2002; Pearse et al. 2009). In asteroids, the two distinct reproductive strategies strongly

drive species distribution patterns and the biogeography of the class in the SO (Moreau et al. 2017).

The present dataset is a compilation of georeferenced occurrences, at species level, for the whole class Asteroidea in the SO. Records from 1872 to 2016 have been gathered from various open source databases. Data collected during recent and unpublished campaigns were also added including records from literature, reaching a total of 13,840 occurrences from 4,580 unique sampling events. This dataset represents the most exhaustive database on Antarctic and Sub-Antarctic asteroids.

Project description

Project title: Antarctic and Sub-Antarctic Asteroidea database

Personnel: Camille Moreau, Charlene Guillaumot, Quentin Jossart, Antonio Agüera, Guillaume Crokaert, Marc Eléaume, Thomas Saucède, Katrin Linse, Huw Griffiths, Chester Sands, David Barnes, Vladimir Laptikhovsky, Anna Jazdzewska, Jacek Siciński, Noémie Vasset, Lenaïg G. Hemery, Christopher Mah, Nadia Améziane, Stefano Schiaparelli, Bruno Danis

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Study area descriptions / descriptor: This study focuses on the Antarctic and Sub-Antarctic regions located at latitudes south of 45°S. The Southern Ocean is a vast region characterised by the paucity of its scientific data (Griffiths 2010; Griffiths et al. 2011) and available collections are the compilation of several historical campaigns. The objective of this work is to integrate the most complete database of species occurrences for the class Asteroidea in the described geographic extent.

Design description: The compilation of occurrence data of asteroid species over the extent of the SO was realised by gathering data available from various biodiversity information systems (OBIS, GBIF, biodiversity.aq, PANGAEA <https://www.pangaea.de/>) as well as published literature, including original manuscripts (e.g., Gutt et al. 2014; Moles et al. 2015), data papers and cruise reports. Compiled occurrences were complemented with data from personal communications of unpublished works and museums registered collections. This extensive dataset was developed to describe distribution patterns in the SO as well as faunal affinities among 25 Antarctic and Sub-Antarctic bioregions (see Moreau et al. 2017). Several analytical methods such as Bootstrap Spanning Network, non-metrical multidimensional scaling (nMDS) and clustering contributed to highlight the importance of the reproductive strategy on the contemporary observed distribution patterns. The importance of environmental parameters such as influence of Antarctic Circumpolar Current (ACC), the influence of the Polar Front (PF), the pres-

ence of gyres or the geographic distance among locations has also been emphasised. This dataset helped to better describe the different biogeographic patterns within asteroids, which are overall congruent with other taxa and differs according to species reproductive strategy. This suggests a differential influence of dispersal capabilities on species distribution patterns. Analyses at genus levels also revealed the underlying legacy of past oceanographic and geodynamic processes in present-day patterns such as the existence of a trans-Antarctic pathway that split the Antarctic continent into two entities in the past. The detailed results are available from Moreau et al. (2017).

Data description: Asteroids are common invertebrates of Antarctic benthic communities considering the relative high species richness of the group in the region with regards to the world total diversity (Danis et al. 2014). They play a significant ecological role in Antarctic ecosystems, including in trophic networks (most species being predators) (Dayton 1972; Lawrence 2013). The present dataset, that focuses on regions located at latitudes higher than 45°S, compiles 28 families out of the 39 known worldwide (Mah 2017) with 13,840 occurrences gathered from various sources. The time coverage of the collection starts in 1872 with the HMS Challenger expedition and ends in 2016 with sampled collected during the *RRS James Clark Ross* JR15005 SO-AntEco cruise.

Associated to occurrence data, depth, relative position to the PF, taxonomic information and bioregion were implemented when available. Depth data were extracted from www.gebco.net. Information regarding the reproductive strategy (brooding or broadcasting) of 63 species out of the 299 described was included in the database. Corresponding bioregions of the observed occurrences were specified following Moreau et al. 2017. A significant part of the specimens is deposited in various institutions: e.g., National Museum of Natural History (NMNH), Museum national d'Histoire naturelle (MNHN), Museo Nazionale dell'Antartide (MNA), Université Libre de Bruxelles (ULB), Museo Argentino de Ciencias Naturales (MACN), National Institute of Water and Atmospheric Research (NIWA).

Quality control description: Data are available at species level. Nomenclature was thoroughly checked using the Taxon Match Tool implemented in the World Register of Marine Species (WoRMS Editorial Board 2016), to delete all potential discrepancies and update the taxonomy determination. All replicates originating from overlapping origins as well as errors regarding the georeferencing, species synonymy, or misspelling were removed. Most of the occurrences additions originating from recent campaigns were identified by Christopher Mah and Camille Moreau.

Taxonomic coverage

General taxonomic coverage description

The present dataset is the most exhaustive and up-to-date list of available occurrences for the class Asteroidea (Echinodermata), in the entire Southern Ocean. This collection

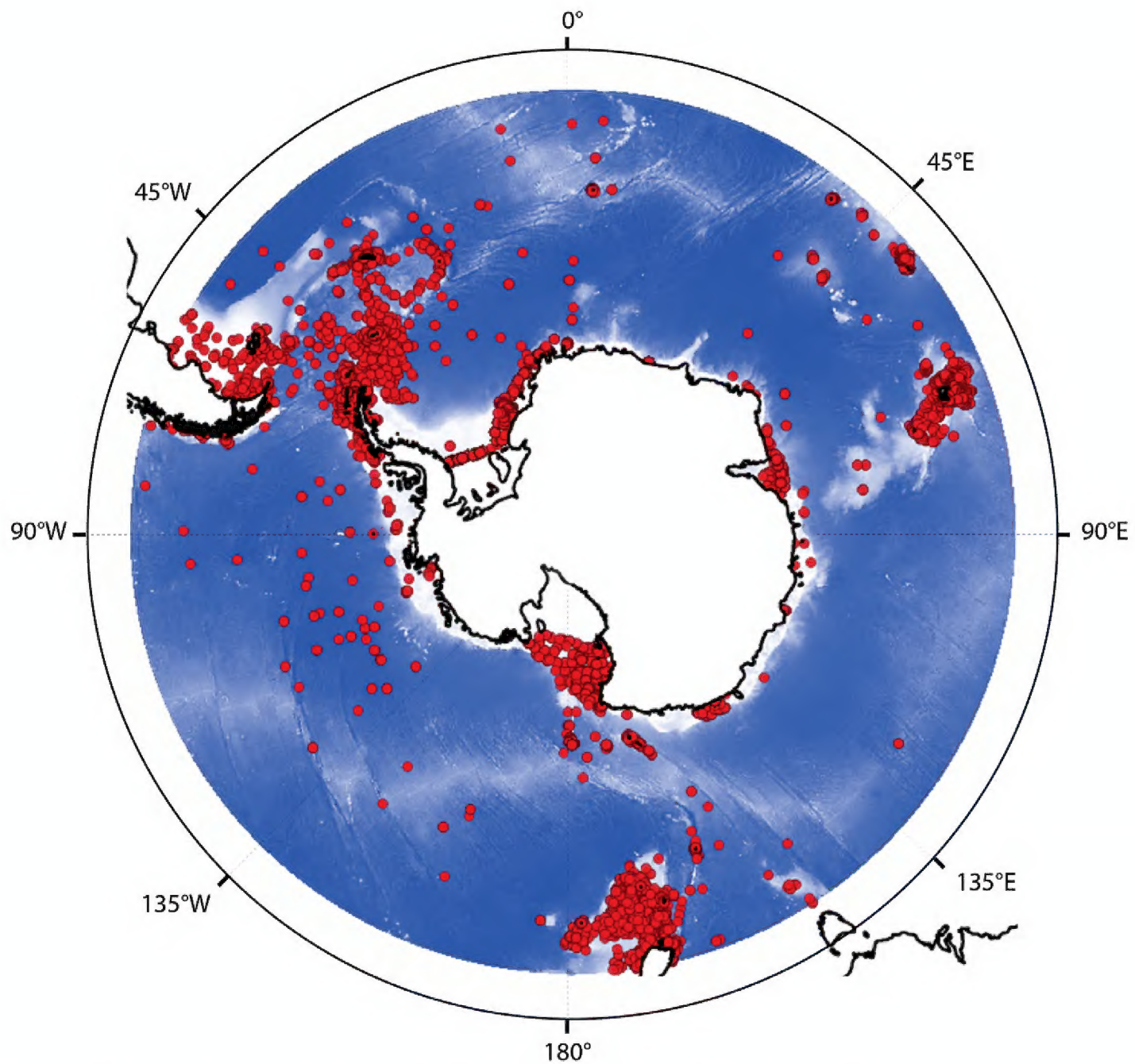


Figure 1. Map of the 13,840 asteroid species occurrences available in the present database, within the boundaries of the Southern Ocean (45°S). Projection: South Pole Stereographic.

provides information about the occurrence of 28 asteroid families, 118 genera, and 299 species. Occurrence distribution is illustrated on Figure 1.

Species richness in the different regions of the SO was estimated based on $1^\circ \times 1^\circ$ grid cell resolution (Figure 2A). Maximum richness (55 species per cell) was found along the Western Antarctic Peninsula. High richness values were also reported in the Weddell Sea as well as in Sub-Antarctic Islands (Kerguelen, Crozet, Marion, and South Georgia Islands). Richness distribution needs to be interpreted carefully considering the patchy and uneven sampling effort of past oceanographic cruises carried out in the SO (Figure 2B). Indeed, considerable parts of the SO present a crucial lack of sampling. In the context of this study, richness values and sampling effort present a significant positive correlation in space (Pearson $r = 0.52$, $p < 0.001$) indicating the need to extend the development of this unique synthesis work and to strengthen the effort for other taxonomic groups.

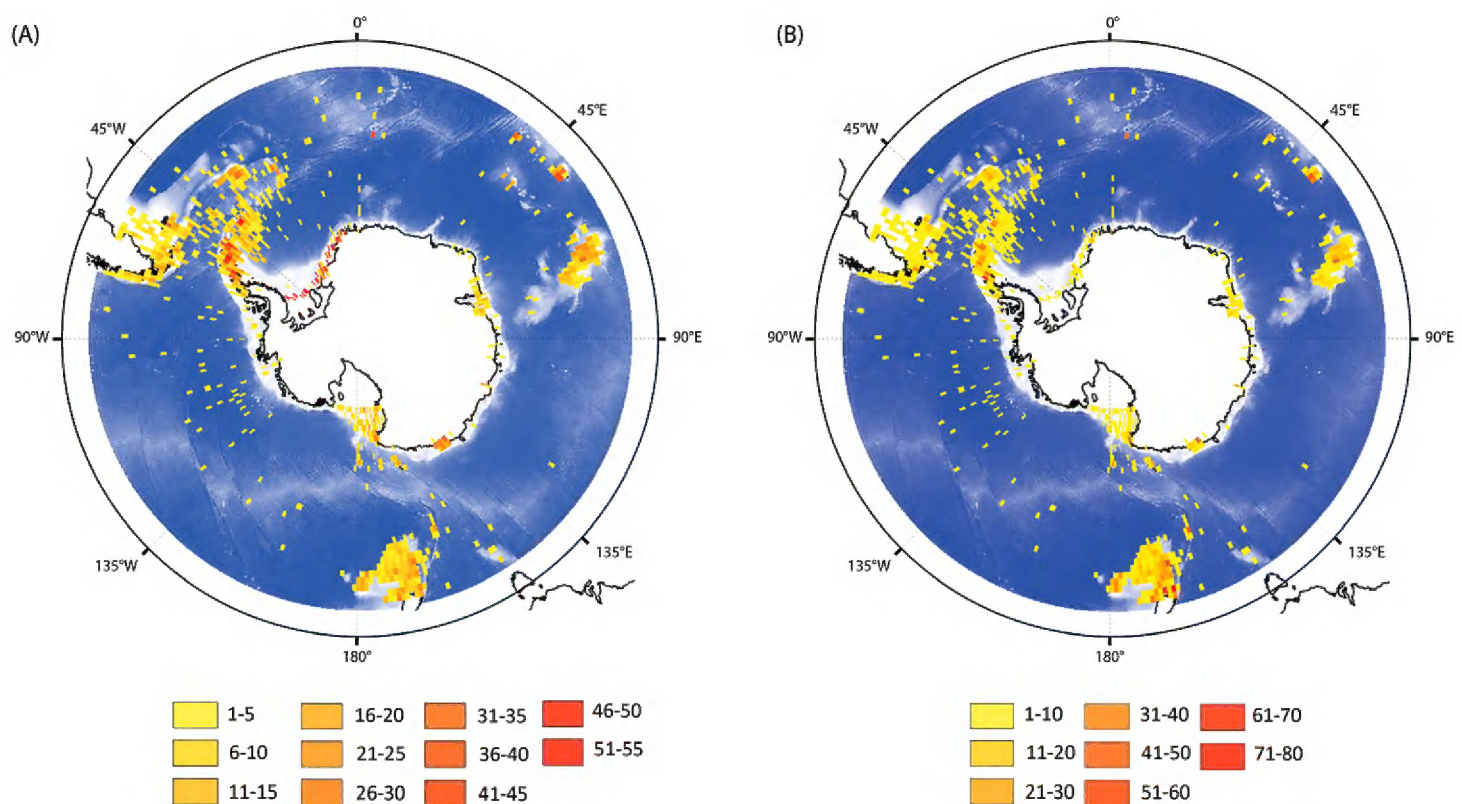


Figure 2. A Species richness in the Southern Ocean. The number of asteroid species present in $1^\circ \times 1^\circ$ grid cells are reported using yellow-red colour chart **B** Sampling effort in the Southern Ocean for the class Asteroidea. The number of sampling station per $1^\circ \times 1^\circ$ grid cell is reported using yellow-red colour chart. Projection: South Pole Stereographic.

Phylum: Echinodermata

Class: Asteroidea

Order: Brisingida, Forcipulatida, Notomyotida, Paxillosida, Spinulosida, Valvatida, Velatida

Family: Acanthasteridae, Asteriidae, Asterinidae, Astropectinidae, Benthoplectinidae, Brisingidae, Ctenodiscidae, Echinasteridae, Freyellidae, Ganeriidae, Goniassteridae, Heliasteridae, Korethrasteridae, Leilasteridae, Luidiidae, Myxasteridae, Odontasteridae, Ophidiasteridae, Paulasteriidae, Pedicellasteridae, Poraniidae, Porcellanasteridae, Pseudarchasteridae, Pterasteridae, Radiasteridae, Solasteridae, Stichasteridae, Zoroasteridae.

Genus: *Abyssaster*, *Acanthaster*, *Acodontaster*, *Adelasterias*, *Allostichaster*, *Anasterias*, *Anseropoda*, *Anteliaster*, *Anthenoides*, *Asterina*, *Asthenactis*, *Astromesites*, *Astropecten*, *Astrosole*, *Bathybiaster*, *Belgicella*, *Benthopecten*, *Brisinga*, *Brisingenes*, *Caimanaster*, *Calyptraster*, *Ceramaster*, *Cheiraster*, *Chitonaster*, *Chondraster*, *Cladaster*, *Clavaporania*, *Coscinasterias*, *Cosmasterias*, *Crossaster*, *Cryptasterias*, *Ctenodiscus*, *Cuenotaster*, *Cycethra*, *Diplasterias*, *Diplodontias*, *Diplopteraster*, *Dipsacaster*, *Dytaster*, *Echinaster*, *Eratosaster*, *Eremicaster*, *Freyastera*, *Freyella*, *Freyellaster*, *Fromia*, *Ganeria*, *Gaussaster*, *Gilbertaster*, *Glabraster*, *Granaster*, *Henricia*, *Hippasteria*, *Hymenaster*, *Hymenodiscus*, *Hyphalaster*, *Kampylaster*, *Kenrickaster*, *Labidiaster*, *Leptychaster*, *Lethasterias*, *Lithosoma*, *Lonchotaster*, *Lophaster*, *Luidia*, *Lysasterias*, *Macroptychaster*, *Mediaster*, *Meridiastra*, *Mimastrella*, *Mirastrella*, *Myxoderma*, *Neosmilaster*, *Notasterias*, *Notioceramus*, *Novodinia*, *Odinella*, *Odontaster*, *Odontohenricia*, *Ophidias-*

ter, *Paralophaster*, *Paranepanthia*, *Patiriella*, *Paulasterias*, *Pectinaster*, *Pedicellaster*, *Pentagonaster*, *Pergamaster*, *Peribolaster*, *Perissasterias*, *Perknaster*, *Persephonaster*, *Pillsburiaster*, *Plutonaster*, *Poraniopsis*, *Porcellanaster*, *Proserpinaster*, *Psalidaster*, *Pseudarchaster*, *Pseudechinaster*, *Psilaster*, *Pteraster*, *Radiaster*, *Remaster*, *Rhopiella*, *Saliasterias*, *Sclerasterias*, *Scotiaster*, *Smilasterias*, *Solaster*, *Sphaeriodiscus*, *Stichaster*, *Styracaster*, *Taranuiaster*, *Tarsaster*, *Tremaster*, *Vemaster*, *Zoroaster*.

Species: *Abyssaster diadematus*, *Abyssaster planus*, *Acanthaster planci*, *Acodontaster capitatus*, *Acodontaster conspicuus*, *Acodontaster elongatus*, *Acodontaster hodgsoni*, *Acodontaster marginatus*, *Adelasterias papillosa*, *Allostichaster capensis*, *Allostichaster farquhari*, *Allostichaster insignis*, *Allostichaster polyplax*, *Anasterias antarctica*, *Anasterias asterinoides*, *Anasterias directa*, *Anasterias laevigata*, *Anasterias mawsoni*, *Anasterias pedicellaris*, *Anasterias perrieri*, *Anasterias rupicola*, *Anasterias sphoerulata*, *Anasterias spirabilis*, *Anasterias studeri*, *Anasterias suteri*, *Anseropoda antarctica*, *Anteliaster australis*, *Anteliaster scaber*, *Anthenoides cristatus*, *Asterina fimbriata*, *Asthenactis australis*, *Astromesites primigenius*, *Astropecten brasiliensis*, *Astrosole scabra*, *Bathybiaster loripes*, *Belgicella racowitzana*, *Benthopecten munidae*, *Benthopecten pedicifer*, *Benthopecten pikei*, *Brisinga chathamica*, *Brisingenes multicostata*, *Caimanaster acutus*, *Calyptaster tenuissimus*, *Calyptaster vitreus*, *Ceramaster australis*, *Ceramaster grenadensis*, *Ceramaster patagonicus*, *Cheiraster* (*Cheiraster*) *otagoensis*, *Cheiraster* (*Luidiaster*) *antarcticus*, *Cheiraster* (*Luidiaster*) *gerlachei*, *Cheiraster* (*Luidiaster*) *hirsutus*, *Cheiraster* (*Luidiaster*) *planeta*, *Chitonaster cataphractus*, *Chitonaster felli*, *Chitonaster johannae*, *Chitonaster trangae*, *Chondraster elattosis*, *Cladaster analogus*, *Clavaporania fitchorum*, *Coscinasterias calamaria*, *Coscinasterias muricata*, *Cosmasterias dyscrita*, *Cosmasterias lurida*, *Crossaster campbellicus*, *Crossaster multispinus*, *Crossaster penicillatus*, *Cryptasterias brachiata*, *Cryptasterias turqueti*, *Ctenodiscus australis*, *Ctenodiscus procurator*, *Cuenotaster involutus*, *Cycethra frigida*, *Cycethra macquariensis*, *Cycethra verrucosa*, *Diplasterias brandti*, *Diplasterias brucei*, *Diplasterias kerguelensis*, *Diplasterias meridionalis*, *Diplasterias octoradiata*, *Diplasterias radiata*, *Diplodontias dilatatus*, *Diplodontias robustus*, *Diplodontias singularis*, *Diplopteraster clarki*, *Diplopteraster hurleyi*, *Diplopteraster otagoensis*, *Diplopteraster peregrinator*, *Diplopteraster semireticulatus*, *Diplopteraster verrucosus*, *Dipsacaster magnificus*, *Dytaster felix*, *Echinaster farquhari*, *Echinaster smithi*, *Eratosaster jenae*, *Eremicaster crassus*, *Eremicaster pacificus*, *Eremicaster vicinus*, *Freyastera benthophila*, *Freyastera tuberculata*, *Freyella attenuata*, *Freyella drygalskii*, *Freyella echinata*, *Freyella formosa*, *Freyella fragilissima*, *Freyella giardi*, *Freyella heroina*, *Freyella mutabilia*, *Freyellaster polycnema*, *Fromia monilis*, *Ganeria attenuata*, *Ganeria falklandica*, *Ganeria hahni*, *Gaussaster antarcticus*, *Gilbertaster anacanthus*, *Glabraster antarctica*, *Granaster nutritrix*, *Henricia aucklandiae*, *Henricia compacta*, *Henricia diffidens*, *Henricia fisheri*, *Henricia lukinsii*, *Henricia obesa*, *Henricia ornata*, *Henricia pagenstecheri*, *Henricia parva*, *Henricia praestans*, *Henricia ralphae*, *Henricia simplex*, *Henricia smilax*, *Henricia spinulfera*, *Henricia studeri*, *Hippasteria falklandica*, *Hippasteria phrygiana*, *Hymenaster caelatus*, *Hymenaster campanulatus*, *Hymenaster carnosus*, *Hymenaster coccinatus*, *Hymenaster crucifer*, *Hymenaster densus*, *Hymenaster edax*, *Hymenaster*

estcourti, *Hymenaster formosus*, *Hymenaster fucatus*, *Hymenaster graniferus*, *Hymenaster latebrosus*, *Hymenaster nobilis*, *Hymenaster pellucidus*, *Hymenaster perspicuus*, *Hymenaster praecoquis*, *Hymenaster pullatus*, *Hymenaster sacculatus*, *Hymenodiscus aotearoa*, *Hymenodiscus distincta*, *Hymenodiscus submembranacea*, *Hyphalaster giganteus*, *Hyphalaster inermis*, *Hyphalaster scotiae*, *Kampylaster incurvatus*, *Kenrickaster pedicellaris*, *Labidiaster annulatus*, *Labidiaster radiosus*, *Leptychaster flexuosus*, *Leptychaster kerguelenensis*, *Leptychaster magnificus*, *Leptychaster melchiorensis*, *Lethasterias australis*, *Lithosoma novaezelandiae*, *Lonchotaster tartareus*, *Lophaster densus*, *Lophaster gaini*, *Lophaster stellans*, *Lophaster tenuis*, *Luidia clathrata*, *Luidia porteri*, *Lysasterias adeliae*, *Lysasterias belgicae*, *Lysasterias chiophora*, *Lysasterias digitata*, *Lysasterias hemiora*, *Lysasterias heteractis*, *Lysasterias joffrei*, *Lysasterias lactea*, *Lysasterias perrieri*, *Macroptychaster accrescens*, *Mediaster arcuatus*, *Mediaster dawsoni*, *Mediaster pedicellaris*, *Mediaster sladeni*, *Meridiastra medius*, *Meridiastra oriens*, *Mimastrella cognata*, *Mirastrella biradialis*, *Myxoderma qawashqari*, *Neosmilaster georgianus*, *Neosmilaster steineni*, *Notasterias armata*, *Notasterias bongraini*, *Notasterias candicans*, *Notasterias haswelli*, *Notasterias pedicellaris*, *Notasterias stolophora*, *Notioceramus anomalus*, *Novodinia novaezelandiae*, *Odinella nutrix*, *Odontaster aucklandensis*, *Odontaster benhami*, *Odontaster meridionalis*, *Odontaster pearsei*, *Odontaster penicillatus*, *Odontaster pusillus*, *Odontaster roseus*, *Odontaster validus*, *Odontohenricia anarea*, *Odontohenricia endeavouri*, *Ophidiaster confertus*, *Paralophaster antarcticus*, *Paralophaster godfroyi*, *Paralophaster hyalinus*, *Paralophaster lorioli*, *Paranepanthia aucklandensis*, *Patiriella regularis*, *Paulasterias tyleri*, *Pectinaster filholi*, *Pectinaster mimicus*, *Pedicellaster hypernotius*, *Pentagonaster pulchellus*, *Pergamaster incertus*, *Pergamaster triseriatus*, *Peribolaster folliculatus*, *Peribolaster lictor*, *Peribolaster macleani*, *Perissasterias monacantha*, *Perknaster antarcticus*, *Perknaster aurantiacus*, *Perknaster aurorae*, *Perknaster charcoti*, *Perknaster densus*, *Perknaster fuscus*, *Perknaster sladeni*, *Persephonaster facetus*, *Pillsburiaster aoteanus*, *Pillsburiaster indutilis*, *Plutonaster complexus*, *Plutonaster fragilis*, *Plutonaster hikurangi*, *Plutonaster jonathani*, *Plutonaster knoxi*, *Plutonaster sirius*, *Poraniopsis echinaster*, *Porcellanaster ceruleus*, *Proserpinaster neozelanicus*, *Psalidaster fisheri*, *Psalidaster mordax*, *Pseudarchaster discus*, *Pseudarchaster garricki*, *Pseudechinaster rubens*, *Psilaster acuminatus*, *Psilaster charcoti*, *Pteraster affinis*, *Pteraster bathami*, *Pteraster florifer*, *Pteraster gibber*, *Pteraster hirsutus*, *Pteraster koehleri*, *Pteraster robertsoni*, *Pteraster rugatus*, *Pteraster spinosissimus*, *Pteraster stellifer*, *Radiaster gracilis*, *Remaster gourdoni*, *Rhopiella hirsuta*, *Saliasterias brachiata*, *Sclerasterias eustyla*, *Sclerasterias mollis*, *Scotiaster inornatus*, *Smilasterias clarkailsa*, *Smilasterias irregularis*, *Smilasterias scalprifera*, *Smilasterias triremis*, *Solaster longoi*, *Solaster notophrynus*, *Solaster regularis*, *Solaster torulatus*, *Sphaeriodiscus mirabilis*, *Stichaster australis*, *Styracaster armatus*, *Styracaster chuni*, *Styracaster horridus*, *Styracaster robustus*, *Taranuiaster novaezelandiae*, *Tarsaster stoichodes*, *Tremaster mirabilis*, *Vemaster sudatlanticus*, *Zoroaster actinocles*, *Zoroaster alternicanthus*, *Zoroaster fulgens*, *Zoroaster macracantha*, *Zoroaster spinulosus*, *Zoroaster tenuis*.

Spatial coverage: Southern Ocean: from 45°S to higher latitudes

Temporal coverage: 1872: HMS Challenger to 2016: JR15005.

Dataset: Asteroid occurrences available in the Southern Ocean from 1872 to 2016, collected during different campaigns and gathered from different deposit resources.

Object name: Antarctic and Sub-Antarctic Asteroidea Database

Character encoding: UTF/8

Format name: Darwin Core Archive Format

Format version: 1.4

Distribution: http://ipt.biodiversity.aq/resource?r=asteroidea_southern_ocean

Publication date of data:

Language: English

Metadata language: English

Date of metadata creation:

Hierarchy level: Dataset

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